

# A literature review of wetland treatment systems used to treat runoff mixtures containing antibiotics and pesticides from urban and agricultural landscapes

## Supplementary Material

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Table S1. Contaminant type and appearances in the primary studies.

Contaminant by Type	Count of Appearance in Primary Studies
<b><u>Nutrients and Carbon</u></b>	
Total Nitrogen	29
Nitrate	15
Ammonia	12
Total Phosphorous	10
Nitrite	4
Other (n=4)	8
<b><u>Pesticide</u></b>	
Atrazine	25
Chlorpyrifos	22
S-Metolachlor	21
Alachlor	16
Isoproturon	14
Other (n=158)	460
<b><u>Antibiotics</u></b>	
Tetracycline	11
Sulfamethoxazole	5
Monensin	3
Narasin	3
Ciprofloxacin	3
Other (n=24)	35
<b><u>Other pharmaceuticals</u></b>	
Carbamazepine	3
Caffeine	2
Diclofenac	2
Fluoxetine	2

Naproxen	2
Other (n=10)	10

**Metals**

Copper	7
Tin	4
Iron	3
Lead	3
Manganese	3
Other (n=17)	23

**Minerals**

Selenium	2
Molybdenum	1
Sodium	1
Vanadium	1

**Industrial Byproducts**

Bisphenol A	2
Uranine	2
5-methyl-1H-benzotriazole	2
Benzotriazole	2
Di-n-butyl phthalate	1
Other (n=8)	7

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**Table S2.** Contaminant removal rates for the primary studies that analyzed both nitrogen and pesticide and/or antibiotics in wetland treatment systems.

Removal Rates (%)						CEC Studied	Scale	Wetland Type	Plant Type	Source
TN	TP	NO <sub>3</sub> -N	NH <sub>4</sub> <sup>+</sup> -N	Pesticide	Antibiotic					
85	N/A	N/A	N/A	87.50	N/A	Atrazine	Full-scale	Wetland Buffer	Typha latifolia	[46]
>20	40-83	0	15-40	N/R	N/A	N/R	Full-scale	HF	Juncus, Typha minima, Equisetum, Pontederia cordata, Iris sp., Canna sp.	[3]
N/A	N/A	70	N/A	54	N/A	Azinphos-methyl	Full-scale	HF	Not reported	[142]
N/A	54-75	70-84	N/A	77-93	N/A	Organophosphorus insecticides	Full-scale	Pond	Typha capensis, Juncus kraussi, Cyperus dives	[106]
15-80	23-26	N/A	N/A	0-67	N/A	Fluroxypyr, Metribuzin, Metamitron, Propachlor, Bentazone, Dicamba, Mecoprop, Propiconazole, MCPA, Dichlorprop, Linuron, Fenpropimorph, Metalaxyl	Full-scale	HF	Sporangium erectum, Phragmites, Phalaris arundinacea, Urtica dioica, Myosotis scorpiodes	[205]
16	12	22	N/A	BD	N/A	Organochlorine pesticides, Polycyclic aromatic hydrocarbons, Trace metals	Full-scale	HF	Turff grass, Littoral vegetation, Emergent vegetation	[213]
N/A	74	97	100	BD	N/A	Monensin, Salinomycin, Narasin	Full-scale	HF	Sagittaria L., Carex lacustris, Sparganium americanum, Eleocharis fallax Weatherby, Carex cristatella, Iris versicolor L. harlequin blueflag, Carex lacustris Willd, Carex lurida, Pontederia cordata L., Spartina pectinata Bosc ex Link, Scirpus fluviatilis (Torrey) Gray, Juncus effusus L., Schoenoplectus tabernaemontani (K.C. Gmel.) Palla, Acorus gramineus Sol. ex Aiton grassleaf, Scirpus pungens Vahl, Nymphaea alba, Scirpus cyperinus, Muphar polysepalem	[99]

65	N/A	58-83	N/A	N/A	N/R	Monensin, Salinomycin, Narasin	Microcosm	FWS, SF	None	[43]
89	85	N/A	N/A	100	N/A	Atrazine, S-metolachlor, Permethrin	Full-scale	Natural wetland	Leersia sp., Cyperus sp., Carex sp., Lemnaceae sp.	[77]
43-98	96-98	0	92-100	80-100	N/A	Atrazine, S-metolachlor, Permethrin	Full-scale	Natural wetland	Leersia sp., Cyperus sp., Carex sp., Lemnaceae sp.	[184]
84-98	11-71	N/A	N/A	50-99	N/A	Atrazine, S-metolachlor, Permethrin	Mesocosm	FWS	Juncus effusus, Phragmites australis	[67]
N/A	N/A	5-11	N/A	-619-100	N/A	Propyzamide, Boscalid, Diflufenicanil, Isoproturon, Propoxycarbazone-Na, Mesosulfuron-methyl, Metasulfuron-methyl, Clopyralid, Cyproconazole, 2,4-MCPA, Propiconazole, Epoxiconazole, OH-Atrazine	Full-scale	Wetland buffer	Juncus conglomeratus, Juncus inflexus, Ranonculus repens, Glyceria notata	[126]
35-98	35-98	N/A	45-98	46-93	N/A	Tebuconazole, Imazalil	Mesocosm	HF	Typha latifolia, Phragmites australis, Iris pseudacorus, Berula erecta, Juncus effusus	[201]
5-99	5-99	N/A	7-99	8-89	N/A	Tebuconazole	Mesocosm	HF	Juncus effusus, Typha latifolia, Berula erecta, Phragmites australis, Iris pseudacorus	[102]
40-99	40-100	29-98	60-95	33-100	N/A	Tebuconazole	Mesocosm	HF	Typha latifolia, Phragmites australis, Iris pseudacorus, Juncus effusus, Berula erecta	[120]
N/A	N/A	N/A	61.7-73	88-95	N/A	Tetracycline	Mesocosm	FWS	Cyperus involucratus	[48]
N/A	N/A	40-98	98-99	N/A	N/R	Ofloxacin, Tetracycline	Microcosm	N/A	Cyperus alternifolius, Typha angustifolia, Lythrum alicaria, Acorus calamus	[131]
N/A	N/A	28-39	72.6-90	N/A	N/R	Ofloxacin	Microcosm	N/A	Cyperus alternifolius, Typha angustifolia	[30]
N/A	N/R	N/R	N/R	88-99	N/A	Chlorpyrifos, 3,5,6-trichloro-2-pyridinol	Mesocosm	SF	Canna indica	[171]
71-90	15-50	N/A	85-90	N/A	79-100	Tetracycline	Mesocosm	HF	Myriophyllum aquaticum	[112]

26-81	15-90	20-95	31-35	N/A	87-97	Levofloxacin	Microcosm	N/A	Juncus, Drimia maritima stearn, Canna indica, Acorus calamus, Iris pseudacorus, Thalia dealbata fraser, Oenanthe javanica DC., Cyperus alternifolius	[97]
40	9	92	85	30-99	35-90	MCPA, Terbutylazine, Tebuconazole, Propanil, Oxadiazine, Molinate, Chlorpyrifos, Bentazone, Atrazine, Alachlor, Triclosan, Primidone, Oxazepam, Naproxen, Lorazepam, Carbamazepine, Benzotriazole, 5TTri, Tributyl phosphate, Caffeine	Full-scale	HF, Rice field	Rice, Helophytic vegetation	[103]
17-85	46-78	47-86	N/A	-48-99	N/A	Acephate, Bifenthrin, Carbaryl, Chlorothalonil, Chlorpyrifos, Dimethenamid, Fipronil, Indaziflam, Isoxaben, Myclobutanil, Oryzalin, Oxadiazon, Oxyfluorfen, Pendimethalin, Propiconazole	Full-scale	SF, FWS	Rice	[159]
N/A	N/A	13-74	80-96	N/A	N/R	Ofloxacin, Tetracycline	Microcosm	N/A	Artificial root exodus	[22]
38-83	62-99	N/A	26-96	N/A	N/R	Levofloxacin	Mesocosm	FTW	Iris pseudoacorus	[113]
26-86	N/A	-113-37	93	N/A	54	Sulfamethoxazole	Mesocosm	VF	None	[114]
33-56	62-77	N/A	N/A	N/A	99.70	Tetracycline	Mesocosm	HF	Vallisneria spiralis	[169]
71	N/A	94	94	N/A	69-93	Ciprofloxacin, Sulfamethazine	Mesocosm	VF	Phragmites communis	[59]
N/A	42-80	N/A	11-65	N/A	55-99	Abamectin	Mesocosm	VF	Not reported	[179]
20-53	39-69	N/A	N/A	N/A	100	Ciprofloxacin	Mesocosm	SF	Vallisneria spiralis	[58]
N/A	BD	0	100	100	N/A	Clopyralid	Full-scale	HF	Typha spp.	[218]

\*N/A means that the contaminant was not present in the runoff mixture and/or was not a focus of the study. N/R means that the contaminant was part of the study but the removal rates of said contaminant were not reported or analyzed. BD means that the contaminant was thought to be in the runoff mixture but upon analysis was not able to be detected.

Horizontal flow constructed wetland (HF); Subsurface flow constructed wetland (SF); Vertical flow constructed wetland (VF); Free-water surface constructed wetland (FWS), Floating treatment wetland (FTW).